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Adaptation trial of coriander (*Coriandrum sativum* L.) varieties in the mid land areas of Guji zone, Southern Ethiopia

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Abstract

Coriander (*Coriandrum sativum* L.) is one of the most important spice and cash crop produced in Ethiopia. However, information related to potential of the midland areas of Guji zone for Coriander production is limited. This experiment was conducted in the Kiltu sorsa, Gobicha and Dole areas at three farmers' field to evaluate the growth and yield performance of Coriander varieties and to select and recommend high yielding as well as diseases resistant Coriander variety(s). Five improved Coriander varieties Walta'i, Batu, Tulu, Indium 01 and Denkinesh were cultivated. The treatments were arranged in randomized completed block design (RCBD) with three replications. Statical analysis indicated significant differences ($P \leq 0.05$) among the Coriander varieties for days to 50% emergence, days to 50% flowering, days to 90% physiological maturity, plant height, number of branches per plant, 1000 seed weight and seed yield. The highest seed yield was recorded from Denkinesh (18.27 qt ha⁻¹) followed by Tulu (13.86 qt ha⁻¹) improved Coriander varieties respectively. But, the lowest seed yield was obtained from Indium 01 variety (1.67 qt ha⁻¹). Accordingly, Coriander improved varieties Denkinesh and Tulu were selected by farmers due to their best performance, adaptability, and highest seed yield. Therefore, these two Denkinesh and Tulu Coriander varieties are recommended in the study area.

Keywords: Adaptation, coriander, improved variety, spice

1. Introduction

Coriander (*Coriandrum sativum* L., $2n=2x=22$) is a diploid annual plant, belonging to the Apiaceae family (Parthasarathy *et al.*, 2008) [20]. *C. sativum* is one of the most useful essential oil bearing spices as well as medicinal plants (Mandal and Mandal, 2015) [15]. The green herb is used as spice and vegetable (Dyulgerov *et al.*, 2013) [6]. The essential and fatty oil of the fruits are used as raw materials for industry and for further processing. In the list of centers of origin of cultivated plants Vavilov (1992) [23] mentioned coriander for Central Asia, the Near East and Abyssinia. It is a culinary and medicinal plant native to Mediterranean and Western Asian regions (Maroufi *et al.*, 2010) [16] and cultivated worldwide (Weiss *et al.*, 2002) [24].

Ethiopia is considered as the homeland for many spices such as korarima, long pepper, black cummin, white cummin/bishops weed and coriander (International Trade Centre, 2010; Hilde and Daphne, 2003) [11, 9]. It is also known as a center of origin and diversity for several plant species including Coriander (Singh *et al.*, 2006) [22]. In Ethiopia, coriander is grown mainly for income generation in addition to local consumption. It is used as a spice in culinary (Diederichsen, 1996) [4], medicine (Kubo *et al.*, 2004; Delaquis *et al.*, 2002) [14, 3] and in perfumery, food, beverage, and pharmaceuticals industries (Jansen, 1981) [12]. Coriander plays also an important role in the Ethiopian domestic spice trade and its seeds are used for the flavoring of 'berbere' (which is a spiced, hot red pepper powder used for numerous meat and vegetarian dishes), 'injera', cakes and bread and its leaves added as an aromatic herb to 'wot' and tea (Jansen, 1981) [12]. Coriander is also a good melliferous plant and studies indicated that one hectare of coriander allows honey bees to collect about 500 kg of honey (Romanenko *et al.*, 1991) [21]. The seed contains significant quantities of carotene, thiamine, riboflavin, niacin, tryptophase, vitamin B6, folate, vitamin C and E (Holland *et al.*, 1991) [10]; it also contains iron, manganese, magnesium and dietary fiber to the diet (Ensminger and Esminger, 1986) [7]. In traditional medicine, one or two teaspoons of coriander juice, added to fresh buttermilk, is highly valuable in treating digestive disorders such as dysentery, indigestion, nausea, hepatitis, ulcer and it is also helpful in typhoid fever.

Dry coriander treats chronic dysentery, diarrhea and as well as acidity problems and indigestion (Jansen and Wageningen, 1981)^[12]. The major producers of coriander in the world are Ukraine, Russia, India, Morocco, Argentina, Mexico, and Romania. Producers from Africa includes Algeria, Egypt, Ethiopia, Somalia and Tunisia. In Ethiopia, coriander is an important cash crop for farmers in the relatively highland areas. It is often cultivated in altitude ranges from 1200 to 2200 m above sea level. It also requires 120 to 400 mm rainfall per growing period. The success of coriander production is influenced by genetic, weather and agronomic factors (Nowak and Szemplinski, 2014)^[18].

Even though Ethiopia is a center of diversity for the crop, the attention given so far in research and development was very limited. In order to diversify its production, availability and increase the income of the farmers, it is important to evaluate the adaptability of improved Coriander varieties to the midland areas of Guji zone. Therefore, this study was initiated with the following objectives:

- To evaluate the growth and yield performance of coriander varieties and
- To select and recommend adaptable and high yielding coriander variety(s) for midlands of Guji zone.

2. Materials and Methods

2.1 Description of the Experimental Site

The experiment was conducted at three locations of Adola district during 2019/2020 cropping season to evaluate the

growth and yield performance of Coriander varieties and to select and recommend high yielding and diseases resistant Coriander variety(s) for midlands of Guji zone. The district is located at about 470 to the south from Addis Abeba. Adola district is characterized by three agro-climatic zones, namely Dega

(High land), Weina-dega (mid land) and Kola (low land) with different coverage. The mean annual rain fall and temperature of the district is about 900 mm and 12-34 °C respectively. There are two cropping seasons i.e Arfasa (main cropping season) which start from March to April especially for maize, haricot bean, sweet potato and Irish potato.

The second cropping season is called Gana (short cropping season) which is practiced as double cropping using small size cereal crops like tef, potato and barley after harvesting the main cropping season crops. This study was also conducted during short cropping season in midland areas of Guji zone.

2.2 Treatments and Experimental Design

The treatments consisted of five released improved Coriander varieties (Indium 01, Walta'i, Batu, Tulu and Denkinesh) were obtained from Tepi and Kulumsa, Sinana and Adami Tulu Agricultural Research Center and evaluated at three on-farms.

Table 1: The improved Coriander varieties released from national and regional research centers in Ethiopia

No.	Name of released variety	Releasing Research Center	Year of release
1.	Walta'i	Sinana research center	2006
2.	Denkinesh	Tepi and Kulumsa ARC	2017
3.	Indium	Debre Zeit research center	2008
4.	Tulu	Adami Tulu research center	2018
5.	Batu	AdamiTulu research center	2018

Source: MoANR (2017 and from Releasing Research Center)

The experimental design was RCBD with three replication and plot size was 2 m * 2.1 m with 0.3m between rows. The spacing between plots and adjacent blocks were 0.4 m and 0.80 m, respectively. Seed rate of 15 kilograms per hectare and fertilizer rates 100 kg of urea (at planting and top dressing) and 100 kg of blended were applied and all agronomic practices such as land preparation and weeding were done uniformly for all treatments.

2.3 Data collected

Phenology and Growth (Days to 50% emergence, Days to 50% flowering, Days to 90% maturity, Plant height (cm), Number of branches per plant), Yield and Yield Components (Number of pods per plant, Number of seeds per pod, 1000 seed weight (g) and Seed yield (kg ha⁻¹))

2.4 Data Analysis

Field data were analyzed by using software (Gen-stat 18 editions) following the standard procedures outlined by Gomez and Gomez (1984). Comparisons among the treatment means were done using Fisher's protected least significant difference (LSD) test at 5% level of significant.

3. Results and Discussion

3.1. Phenology and growth

The analysis of variance (ANOVA) was performed for phenology and growth variables of five Coriander varieties planted at Kiltu sorsa, Gobicha, and Dole on-farm. Over all locations Analysis of variance showed statistically significant differences ($P < 0.05$) were observed among varieties, locations and their interaction for days to 90% physiological maturity, and plant height. However, non-significant difference at ($P > 0.05$) was observed among the locations for days to 50% emergence and flowering, and number of branches (Table 2).

The mean values for the five (5) varieties are shown (Table 2). The variation with respect to days to emergence, flowering, and maturity were ranged from 17.67 to 20.22, 53.67 to 58, and 96 to 110.3 days respectively. As over all location mean value indicate that the longest days to 50% emergence was recorded from walta'i variety (20.22 days) followed by Batu variety (19.22 days) respectively. However, early emergence was recorded for Indium 01 variety (17.67days) followed by Tulu variety (18.78 days).

In other cases, Denkinesh and Tulu varieties were late flowering and maturing (58 and 110.3 days) respectively whereas among the tested varieties, Tulu and Batu, and Indium 01 were early flowering and maturing with (53.67 and 96 days) respectively. The overall location mean values revealed that the longest plant height and highest number of

branches per plant was exhibited from Denkinesh variety (118.24cm and 4.07) respectively. However, the shortest plant height and lowest number of branches per plant was recorded Indium 01 variety (59.83cm and 1.02) respectively (Table 2)

Table 2: The overall locations (Dole, Gobicha and Kiltu sorsa) mean values of phenology and Growth traits of coriander varieties in 2019/20 cropping season

Variety	Phenology, and Growth traits mean				
	Days to 50% Emergence	Days to 50% Flowering	Days to 90% physiological maturity	Plant height(cm)	No. branches /plant
Denkinesh	19.13 ^{ab}	58 ^a	106 ^b	118.24 ^a	4.07 ^a
Tulu	18.78 ^{bc}	53.67 ^b	110.3 ^a	94.14 ^b	2.56 ^b
Batu	19.22 ^{ab}	53.67 ^b	100 ^c	86.69 ^b	2.36 ^b
Walta'i	20.22 ^a	54.33 ^b	96.4 ^d	69.44 ^c	1.96 ^c
Indium 01	17.67 ^c	58 ^a	96 ^d	47.69 ^d	1.02 ^d
Significance level					
Replication	5.36 ^{**}	14.6 ^{**}	0.36 ^{ns}	399.55 ^{**}	0.03 ^{ns}
Variety	7.81 ^{**}	46.3 ^{***}	351.02 ^{***}	6320.92 ^{***}	11.09 ^{***}
Location	0.16 ^{ns}	12.8 ^{ns}	6.69 ^{***}	1398.72 ^{***}	0.05 ^{ns}
Variety * Location	1.04 ^{ns}	3.1 ^{ns}	3.52 ^{***}	291.14 ^{**}	0.24 ^{ns}
Error	47.28	4.23	0.36	102.72	0.11
Cv (%)	6.82	3.7	0.59	12.18	13.9

*, **, ***= significant at $p < 0.05$, at $p < 0.01$, and at $p < 0.001$ respectively, at $p > 0.05$ =non-significant (ns) Mean values sharing the same letter in each column for each factor have no-significant difference at 5% probability according to Fisher's protected test at 5% level of significance and CV (%) = Coefficient of variation

3.2 Yield and yield components

The overall locations analysis of variance showed statistically significant differences ($P < 0.05$) among varieties and locations for seed yield. In the other hand, among varieties significant differences were observed at ($P < 0.05$) for thousand seed weight. However, non-significant difference at ($P > 0.05$) was observed among the locations for thousand seed weight (Table 3).

The overall location mean values revealed that the highest thousand seed weight were obtained from Denkinesh variety (42.78 g) followed by Tulu variety (37.11 g) respectively whereas the lowest thousand seed weight from Indium 01 variety (21.67 g) followed by Walta'i variety (32 g) was recorded respectively. The weight of thousand seeds of the tested accessions ranged from 9.8 to 12.8 g, which is in

agreement with the previous studies of Arganosa *et al.* (1998)^[1]. In other cases, the highest seed yield was obtained from Denkinesh variety (18.27 qtha⁻¹) followed by Tulu variety (13.86 qtha⁻¹) respectively whereas the lowest seed yield Indium 01 variety (1.67 qtha⁻¹) followed by Walta'i variety (8.68 qtha⁻¹) was recorded respectively (Table 3). The results of this study are also consistent with that of (Nowak and Szemplinski, 2014)^[19] who reported that the success of coriander production is influenced by genetic, weather and agronomic factors. Moreover, this suggestion is in agreement with that of Golam *et al.* (2014)^[8] Environmental and genetic parameters can affect plants performance. Furthermore, no similar with that of Diederichsen (1996)^[5] reported a seed yield of 30 qt/ha under optimum conditions.

Table 3: The overall locations (Dole, Gobicha and Kiltu sorsa) mean values of thousand seed weight, and Seed yield traits of Coriander in 2019/20 cropping season

Variety	Yield and yield component traits mean	
	1000 seed weight(g)	Seed yield(qtha ⁻¹)
Denkinesh	42.78a	18.27a
Tulu	37.11b	13.86ab
Batu	32.44c	13.59ab
Walta'i	32c	8.68b
Indium 01	21.67d	1.67c
Significance level		
Replication	2.07	3.33 ^{ns}
Variety	544.63 ^{***}	359.88 ^{***}
Location	6.47 ^{ns}	128.49 ^{**}
Variety* Location	12.72 ^{ns}	42.02 ^{ns}
Error	8.85	31.40
Cv (%)	8.96	14.9

*, **, ***= significant at $p < 0.05$, at $p < 0.01$, and at $p < 0.001$ respectively, at $p > 0.05$ =non-significant (ns) Mean values sharing the same letter in each column for each factor have no-significant difference at 5% probability according to Fisher's protected test at 5% level of significance and CV (%) = Coefficient of variation

4. Conclusion A

In midland areas of Guji zone where new improved spice are not widely addressed, it's vital to catch immediate action towards setting appropriate way of addressing new technologies. In such case, evaluation and adaptation varieties are an effective tool in facilitating selection of the improved coriander technologies. The analysis of overall location mean values revealed that the highest seed yield recorded from Denkinesh (18.27 qtha⁻¹) followed by Tulu (13.86 qtha⁻¹) improved coriander varieties respectively. However, the lowest seed yield was recorded from Indium 01(1.67 qtha⁻¹). Therefore, based on agronomic data results two improved coriander varieties i.e. Denkinesh and Tulu are selected and recommended for midland areas of Guji zone.

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